Title of the Invention

Roaming from IMS Domain to the CS Domain

5 Field of the Invention

The present invention relates to a method of routing a
terminated call to a subscriber from an Internet protocol
based domain to a circuit switched domain. In addition,
10 the present invention also relates to a serving call
state control functionality device and a home subscriber
service device for routing a terminated call to a
subscriber from an Internet protocol based domain to a
circuit switched domain.

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Background of the Invention

With the increasing extension of the Internet Protocol
(IP) to all communication fields including telephony and
20 particularly mobile telephony, not only a large amount of
networking of different systems becomes possible, but
also demands occur to provide for a smooth user handling
between all accessible communication systems. However,
the accessible communication systems also include non-IP
25 related communication systems, for example circuit
switched (CS) domains as the GSM network.

Hence, the problem is present that a user may be
subscriber to an Internet Protocol Multimedia System
30 (IMS) domain as well as to a CS domain. Thus, such users
wish to roam between the domains they subscribe to.
Several specific technical problems are connected
therewith from which the present invention is directed to
the problem of routing terminated calls from the IMS side
35 to the CS side.

Summary of the Invention

Therefore, it is an object of the present invention to
provide a simple and efficient method of enabling roaming
from an Internet Protocol based domain to a circuit
switched domain.

According to the present invention, this object is solved
by providing a method of routing a terminated call to a
subscriber from an Internet Protocol based domain to a
circuit switched domain, wherein said Internet Protocol
based domain has call state control functionalities
implemented, said method comprising the steps of
receiving an invitation of said subscriber for a call by
at least one call state control functionality within said
Internet Protocol based domain; obtaining the profile of
said subscriber from said home subscriber serving means
to a call state control functionality; requesting further
routing information from said home subscriber serving
means; requesting a switching means within said circuit
switched domain currently visited by said subscriber for
said roaming number by said home subscriber serving
means; returning said roaming number of said subscriber
to said home subscriber serving means by said visited
switching means; returning said roaming number as said
further routing information from said home subscriber
serving means to said call state control functionality;
and establishing said call via gateway means for
connecting said domains as well as via said visited
switching means to said subscriber.

With the method according to the present invention, an
IMS subscriber with a subscription providing access to
one or more domains is allowed to roam from an Internet

Protocol based domain to a circuit switched domain in a simple and efficient way. The CS domain functionalities can remain unchanged as contribution to the interworking between the Internet Protocol based domain and the CS

5   domain. Further, with the method according to the present invention, the call can be kept longer in the IP based domain side which is in turn connected with several other advantages.

10   While the method according to the present invention is not bounded to any particular implementation of a call state control functionality, an option can be considered where said call state control functionality is implemented into two entities.

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Accordingly, as an option of the method according to the present invention, subsequent to the receipt of said invitation, a step of requesting the location of said subscriber from said home subscriber serving means is

20   performed; an indication from a serving means for home subscriber within said Internet Protocol based domain that said subscriber is not registered within said Internet Protocol based domain is returned; and subsequent to said return of an indication, a step of

25   inviting another call state control functionality for said call is performed, wherein said other call state control functionality performs all subsequent steps mentioned in claim 1 as related to said call state control functionality.

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Regarding said home subscriber serving means, the method according to the present invention is not limited to a particular architecture of the IMS domain with respect to that. For example, a home location registering means can

35   be external to said home subscriber serving means. Thus,

a new interface and also a new functionality would have
to be introduced between said home subscriber serving
means and said external home location registering means.
Some properties of this interface would be to facilitate
the roaming number inquiry by the home subscriber serving
means, to provide a different inquiry for the request of
said further routing information, because CS domain
service are overridden in the home location registering
means, and to be accessible from other elements than said
home subscriber serving means which means that said
routing number inquiry may be started from other
entities.

However, the method according to the present invention
can be readily brought into coincidence with a home
subscriber serving means which is a combination of a
mobility serving means (IP multimedia functionality) of
the IP based domain with a home location registering
means (subset of HLR functionality) of the CS based
domain.

Accordingly, in the method according to the present
invention, if an IP multimedia functionality and a subset
of home location registering functionality are integrated
into said home subscriber serving means, then said
registering request, if applicable, and return is
performed with said IP multimedia part; said profile
request and download is performed with said IP multimedia
part; said roaming number provision requesting step as
executed to said home subscriber serving means is
performed with said IP multimedia part; subsequent
thereto, a step of requesting said home location
registering part for the provision of the roaming number
of said subscriber is performed by said IP multimedia
part; said roaming number provision requesting step as

executed to said visited switching means is performed
with said home location registering part; said roaming
number returning step as executed by said visited
switching means is performed with said home location
5   registering part; subsequent thereto, a step of returning
said roaming number from said home location registering
part to said IP multimedia part within said home
subscriber serving means is performed; and said roaming
number returning step as executed to said serving call
10 state control functionality is performed by said IP
multimedia part.

Thus, as an advantageous embodiment of the present
invention, there is provided a home subscriber serving
15 device capable of using routing information for
terminating a call to a subscriber, comprising an IP
multimedia part and a home location registering part
interfaced to each other, wherein said home location
registering part comprises transceiver means capable of
20 requesting and receiving roaming numbers from the circuit
switched domain.

In the present field which is still under development, it
may be necessary or desirable that certain terminating
25 call related service functions are overridden.

Hence, as further modification of the method according to
the present invention, the step of requesting further
routing information from said home subscriber serving
30 means can involve the overriding of at least one
terminating call related service functionality within
said home subscriber serving means.

As further solution of the present object, according to
35 the present invention a serving call state control

functionality device for providing a routing service to a circuit switched domain is provided, said serving call state control functionality device providing a functionality of an Internet Protocol based domain and
5   comprising means which are adapted to perform related steps of the method according to the present invention or modifications thereof.

Thus, services of the Internet Protocol based domain can
10   be provided for the roaming subscriber (to the Internet Protocol based domain) within this serving call state control functionality device. Additionally, there can be some services, e.g. roaming leg charging which are provided in the S-CSCF (by IMS service). In other words,
15   although the services are IMS services, they can have CS flavor, because the roaming service needs to take CS aspects into account.

The present invention will become more apparent from the
20   following detailed description of the preferred embodiments when taken in conjunction with the accompanying drawings.

Brief Description of the Drawings
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Fig. 1 shows a circuit switched routing service of a serving call state control functionality of an Internet Protocol based domain under consideration of a solution having a home subscriber serving means as an
30   implementation of the method according to the present invention.

Description of the Preferred Embodiments

35   As mentioned above, the present invention aims to provide

the possibility of routing a terminated call from an
Internet Protocol based domain such as the Internet
Protocol Multimedia System IMS to a circuit switched
domain CS such as the GSM network. This is necessary in a
5   situation when a user is subscriber in both the IMS
domain and the CS domain, and a call is terminated to the
user, for example, while being unregistered in the IMS
side.

10   This situation is depicted in Fig. 1 where the subscriber
is invited for a call in a step S1 at an interrogating
call state control function I-CSCF of the IMS domain. The
elements at the left hand side of the dotted line in Fig.
1 are part of the IMS domain while the right hand side
15   constitutes the CS domain. In step S2, the I-CSCF
requests the location of the called subscriber from the
home subscriber server HSS.

Here, description is made with respect to the
20   functionalities related to a call state control
functionality (CSCF) being divided into an interrogating
CSCF and a serving CSCF. However, the present invention
is not limited thereto, these functionalities can also be
implemented in only one entity or in more than two.
25
Here, as one preferred embodiment of the present
invention, a home subscriber server HSS is considered
where this HSS comprises the subset of the HLR
functionality to support roaming to GSM/UMTS CS domain
30   networks and the IP multimedia functionality. In this
case, these parts of the home subscriber server do have
an internal interface over which they communicate.

As other options, the home subscriber server can be of
any other kind (e.g. a single entity) or even be replaced
by any entity acting equivalently.

5   However, the present invention can advantageously make
use of the above mentioned preferred embodiment, although
being not bound thereto, i.e. the structure of the home
subscriber server HSS is not essential for the method
according to the present invention.

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Anyway, the following description is given by considering
the home subscriber server having an IP multimedia
functionality interfaced to a subset of HLR
functionality.

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That is, the above mentioned step S2 is directed to the
IP multimedia functionality of the home subscriber server
HSS and, in a step S3, this part returns the information
to the interrogating call state control function I-CSCF

20   that the subscriber is presently not registered in the
IMS domain.

Next, the interrogating call state control function
I-CSCF invites a serving call state control function

25   S-CSCF which supports terminated sessions for
unregistered subscriber by default. This constitutes step
S4.

As the serving call state control functionality S-CSCF

30   needs the subscriber's user profile, it initiates a
respective download by a request to the IP multimedia
functionality within the HSS. These actions correspond to
steps S5 and S6, respectively.

As one embodiment of the present invention, messages for indication returning (step S3) and profile obtaining (step S5) are implemented as a single message.

5   However, also in this case steps S3 and S5 can still be perceived as logically separate, since the receiving of said indication and the obtaining of the profile are two independent functions.

10   In the method of the present invention according to Fig. 1, thereafter, as a preferred embodiment of the present invention, the serving call state control function S-CSCF initiates a routing service to the circuit switched domain, starting with step S7 in which further routing
15   information is requested from the IP multimedia functionality within the HSS. Within the HSS the functionality responsible for the IP Multimedia (IM) contacts the home location register part of the HSS in a step S8, to formulate the roaming number query.
20

Then, a query to provide the roaming number of the subscriber as the above mentioned further routing information is performed. That is, the mobile services switching center VMSC of the circuit switched domain
25   which the subscriber currently visits is requested for the roaming number, constituting step S9. In response thereto, a step S10 is performed where the visited mobile services switching center VMSC returns the roaming number back to the home location register HLR. The home location
30   register HLR part of the HSS, in turn, returns the roaming number in a step S11 to the functionality handling the IM which executes step S12, returning this roaming number back to the serving call state control function S-CSCF.

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Having the roaming number, the serving call state control
function S-CSCF can continue the call routing on the
basis of this information. This means that the call is
finally established via the breakout gateway control
5 function BGCF, the media gateway control function MGCF,
the signaling gateway function SGW, and the visited
mobile services switching center VMSC to the terminal of
the subscriber. This is indicated by steps S131-S134.

10 The query for obtaining the roaming number from the
visited mobile services switching center VMSC
corresponding to steps S9 and S10 can be performed by
exchanging messages "Provide Roaming Number" and "Provide
Roaming Number acknowledgment", respectively.
15

The query requesting the further routing information
which corresponds to steps S7 and S12 can be performed by
exchanging messages "Cx_Location_query" and
"Cx_Location_query_Resp", respectively. These messages
20 are then part of the Cx-interface.

Thus, as the requested further information, the serving
call state control function S-CSCF can obtain a "Mobile
Station Roaming Number" MSRN.
25

Generally speaking, while it is possible with the present
invention that the IMS services are provided within the
serving call state control function S-CSCF for the
roaming IMS subscriber, it may be that it is unwanted
30 that services of the CS domain are introduced to the
serving call state control function S-CSCF. Hence, it is
an option that services of said home location register
HLR related to said CS domain are overridden by said CS
routing service of the serving call state control
35 function S-CSCF.

The services of said home location register related to CS domain are hereafter referred to as the CS services. The CS services overridden in the method of this invention

5   are typically the ones related to terminating calls.

The terminating call CS service functionalities would typically be invoked when the routing information is requested from the home location register, or in this

10   case from the HSS (S7). The invocation means that as the routing information request arrives to the home location register, it starts to process the functionalities for the CS services. These services typically include incoming call barring, closed user group (CUG) and call

15   forwarding - especially call forwarding unconditional (CFU) and the terminating call Camel services (CAMEL: customized applications for mobile networks enhanced logic).

20   For instance, the functionalities that must be overridden are the ones that would hinder the routing of the terminating call leg directly to the subscriber in the CS domain such as call forwarding or incoming call barring. Similarly, the functionalities that must be overridden

25   include the ones that would indicate service invocation requests to the HSS/HLR inquiring node, which is normally a circuit switched gateway MSC, however, in this case the S-CSCF. These service invocation requests would typically be such that their fulfillment requires such service

30   functionalities in the S-CSCF that are unnecessary for the simple routing of a terminating call leg to the CS side for the subscriber. The terminating call leg from the S-CSCF to the VMSC can be seen as a direct pipe not involving supplementary services that would affect call

35   routing. The service functionalities in the S-CSCF that

are unnecessary for the simple routing of a terminating call leg include for instance the Camel gsmSSF functionalities for the GMSC or the IMSC (the one inquiring the HLR normally). Therefore, no Camel service
5 information (CSI, T-CSI) are returned from the HSS and no triggering to the CSE from the S-CSCF is required during the course of the CS terminating call leg set-up from the S-CSCF to the VMSC.

10 Furthermore, in the case of call forwarding unconditional, the service functionality would obtain the forwarded-to number from the subscriber database and return it in routing information request response, instead of sending the provide roaming number request to
15 the VMSC/VLR. In the case of terminating call Camel functionalities, the service functionality would return the terminating Camel service information (T-CSI) obtained from subscriber database in the routing information request response. The T-CSI would then be
20 processed by the inquiring node i.e. GMSC or S-CSCF to send an inquiry to the Camel service environment (CSE). The service logic for terminating call Camel services would then be executed in the Camel service environment (CSE).
25
Especially the performing of the inquiry to the Camel service environment would be a problem for the S-CSCF, since the terminal call IP multimedia services belong to its responsibility. These services may be overlapping
30 with the terminating CS services.

In the preferred embodiments of this invention, the service functionalities for the terminating call CS services are not started in the HSS when it is detected
35 by the HSS that the routing information request (S7) is

from a S-CSCF and/or relating to terminating call routing
towards CS side for a dual subscription subscriber. For
instance, this can be detected by inspecting the source
address of the routing information request message.

5 Alternatively, there can be a dedicated message for the
routing information request for the purpose of the
overriding of the service functionalities for the
terminating call CS services. Similarly, an indicator in
a routing information request message can be used.

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A preferred embodiment of the present invention is an
implementation where the home subscriber server HSS is
used with the Provide Roaming Number query being
performed with messages as described. Another preferred

15 embodiment is that services of the CS domain are not
introduced to the serving call state control function
S-CSCF. Hence, a fully compatibility to the existing
standards e.g. or GSM/UMTS/3GGP at the time of the
present invention is aimed. However, depending on the

20 implementation, some "flavor" of CS services may need to
be included into the CS routing service. Anyway, the
services in HLR should be overridden and all services are
executed in the serving CSCF.

25 Included in the above description is a method of routing
a terminated call to a subscriber from an Internet
Protocol based domain to a circuit switched domain,
wherein said Internet Protocol based domain has call
state control functionalities implemented, said method

30 comprising the steps of receiving an invitation of said
subscriber for a call by at least one call state control
functionality within said Internet Protocol based domain;
obtaining the profile of said subscriber from said home
subscriber serving means to a call state control

35 functionality; requesting further routing information

from said home subscriber serving means; requesting a
switching means within said circuit switched domain
currently visited by said subscriber for said roaming
number by said home subscriber serving means; returning
5   said roaming number of said subscriber to said home
subscriber serving means by said visited switching means;
returning said roaming number as said further routing
information from said home subscriber serving means to
said call state control functionality; and establishing
10   said call via gateway means for connecting said domains
as well as via said visited switching means to said
subscriber.

As is understood from the present description by those
15   who are skilled in the art, the present invention can be
applied to many technical fields, and changes and
modifications may be effected to the presently preferred
embodiments without departing from the scope of the
appended claims.

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